REMARKS

Pending Claims:

Claims 1, 2, 4-17, and 19-42 are currently pending in the present application. Claims 1, 4, 5, 6, 8, 12, 16, 19, 20, 21, 25, and 27-30 are amended by the present Amendment. Claims 3 and 18 are cancelled without prejudice to Applicant's right to right to pursue these claims in this or a subsequent application. Claims 31-42 are added by the present Amendment. Upon entry of the present Amendment, reconsideration of claims 1, 2, 4-17, and 19-30 and consideration of new claims 31-42 is respectfully requested.

Rejections under 35 U.S.C. §102(b) As Being Anticipated by Kouznetsov:

Claims 1, 3, 6-8, 11-19, 23-25, and 30 are rejected under 35 U.S.C. §102(b) as being anticipated by Kouznetsov (WO98/40532) (hereinafter "Kouznetsov"). Independent claims 1, 16, and 30 are herein amended to more clearly recite the invention.

To anticipate a claim under 35 U.S.C. §102, a single reference must teach every aspect of the claimed invention either explicitly or implicdly. Any feature not directly taught by the reference must be inherently present in the reference. Thus, a claim is anticipated by a reference only if each and every element of the claim is described, either expressly or inherently, in a single prior art reference.

Independent Claim 1 and Dependent Claims 3, 6-8, and 11-15

The Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 1 as currently amended. Independent claim 1 has been amended to recite a sputtering source having a power supply that generates a voltage pulse between an anode and a cathode assembly. An amplitude and a rise time of the voltage pulse are chosen to increase a density of ions enough to generate sufficient thermal energy in the sputtering target to cause a sputtering yield from the sputtering target to be non-linearly related to a temperature of the sputtering target. As described in the originally-filed specification with reference to FIG. 8, the sputtering yield is a function of the temperature of the target in a thermal sputtering process according to the present invention.

The Applicant submits that there is no description or teaching in Kouznetsov of a power supply that generates a voltage pulse having an amplitude and a rise time that are chosen to increase a density of ions enough to generate sufficient thermal energy in the sputtering target to cause a sputtering yield from the sputtering target to be non-linearly related to a temperature of the sputtering target. Instead, Kouznetsov describes a pulse shape having a steep rising edge up to a peak voltage and then decreases exponentially (See page 5, lines 28-30).

During the period in which the power supply described in Kouznetsov (hereinafter "Kouznetsov power supply") generates the fully-ionized plasma, the voltage level decreases. The Kouznetsov power supply does not choose a voltage amplitude as recited in amended claim 1 to generate a high density of ions. Rather, the Applicant believes that the Kouznetsov power supply generates an output voltage that decreases to a level that is determined by the voltage associated with the state of the fully-ionized plasma (See Kouznetsov page 12, lines 23-26). In other words, the Applicant believes that the output voltage level of the Kouznetsov power supply is automatically chosen depending on the properties of the plasma and the interaction of the power supply with the plasma. The Applicant, therefore, submits that there is no description in Kouznetsov of choosing an amplitude and a rise time of the pulse to increase a density of the ions enough to cause the sputtering yield to be non-linearly related to the temperature of the target.

In view of the above remarks, the Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 1 as currently amended, either expressly or inherently. Therefore, the Applicant submits that Kouznetsov does not anticipate independent claim 1 as currently amended under 35 U.S.C. §102(b). Thus, the Applicant submits that independent claim 1 as currently amended is allowable. The Applicant also submits that dependent claims 3, 6-8, and 11-15 are allowable as depending from an allowable base claim.

Independent Claim 16 and Dependent Claims 17-19 and 23-25

The Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 16 as currently amended. Independent claim 16 has been amended to recite a method for high deposition rate sputtering including applying a voltage pulse to a

cathode assembly having a sputtering target. An amplitude and rise time of the voltage pulse are chosen to increase a density of ions to generate sufficient thermal energy in the sputtering target to cause a sputtering yield from the sputtering target to be non-linearly related to a temperature of the sputtering target.

The Applicant submits that there is no description or teaching in Kouznetsov of applying a voltage pulse to the cathode where the amplitude and the rise time of the voltage pulse are chosen to generate sufficient thermal energy in the sputtering target to cause a sputtering yield from the sputtering target to be non-linearly related to a temperature of the sputtering target. Instead, as described herein, the Kouznetsov power supply generates a pulse shape that has a steep rising edge up to a peak voltage and then decreases exponentially (See page 5, lines 28-30). The Applicant believes that the Kouznetsov power supply generates an output voltage that decreases to a level that is determined by the voltage associated with the state of the fully-ionized plasma (See Kouznetsov page 12, lines 23-26). The Applicant submits that there is no description in Kouznetsov of choosing an amplitude and a rise time of the pulse to cause the sputtering yield to be non-linearly related to the temperature of the target as claimed in independent claim 16 as currently amended.

In view of the above remarks, the Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 16 as currently amended, either expressly or inherently. Therefore, the Applicant submits that Kouznetsov does not anticipate independent claim 16 as currently amended under 35 U.S.C. §102(b). Thus, the Applicant submits that independent claim 16 as currently amended is allowable. The Applicant also submits that dependent claims 17-19 and 23-25 are allowable as depending from an allowable base claim.

Independent Claim 30

The Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 30 as currently amended. Independent claim 30 has been amended to recite a sputtering source including a means for increasing the density of a weakly-ionized plasma to generate a strongly-ionized plasma having a density of ions that generate sufficient thermal energy in the sputtering target to cause a sputtering yield from the sputtering target to be

non-linearly related to a temperature of the sputtering target. As described herein, the Applicant submits that the sputtering yield in the apparatus described in Kouznetsov is not non-linearly related to a temperature of the sputtering target as recited in independent claim 30.

In view of the above remarks, the Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 30 as currently amended, either expressly or inherently. Therefore, the Applicant submits that Kouznetsov does not anticipate independent claim 30 as currently amended under 35 U.S.C. §102(b). Thus, the Applicant submits that independent claim 30 as currently amended is allowable.

Rejections under 35 U.S.C. §103 as being Unpatentable Over Kouznetsov in View of Fortov:

Claims 1, 3, 6-19, 23-25, and 30 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kouznetsov in view of Fortov, "Encyclopedia of Low Temperature Plasma", Volume 3, page 123, 2000 (hereinafter "Fortov").

To be unpatentable under 35 U.S.C. §103(a), the differences between the subject matter sought to be patented and the prior art must be such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or combine the reference teachings. To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.

Independent Claim 1 and Dependent Claims 3 and 6-15

Independent claim 1 has been amended to recite a sputtering source including a power supply that generates a voltage pulse having an amplitude and a rise time that are chosen to increase the density of ions in the strongly ionized plasma enough to generate sufficient thermal energy in the sputtering target to cause a sputtering yield to be non-linearly related to a temperature of the sputtering target. This condition corresponds to the region 504 in FIG. 8 of the present application. The temperature of the target in the region 504 is equal to or greater than the melting point of the target material. Thus, by choosing the amplitude and the rise time of the

voltage pulse generated by the power supply as recited in amended claim 1, the density of ions in the plasma will be large enough so that target material is sputtered so rapidly that a large portion of the heat generated at the surface of the sputtering target is dissipated in the sputtered material and does not penetrate deeply into the sputtering target. Thus, the average temperature of the sputtering target remains relatively low and the sputtering target does not require external cooling.

The Applicant believes that the sputtering apparatus described in Kouznetsov uses a conventional sputtering process in which the average temperature of the sputtering target increases as ions in the plasma bombard the sputtering target. Kouznetsov, describes a very rapid temperature increase in the target and commercially available cooling circuits that are used to dissipate the heat (see Kouznetsov page 10 lines 24-34). The Applicant believes that the sputtering yield in the apparatus described in Kouznetsov is substantially constant during the discharge pulses because cooling circuits are used to dissipate the heat. Therefore, the Applicant submits that the sputtering yield in the apparatus described in Kouznetsov is not non-linearly related to a temperature of the sputtering target as recited in independent claim 1.

Fortov describes the relationship between the sputtering yield and the temperature of the target, but does not describe how to achieve the non-linear relationship between the sputtering yield and the target temperature. The Applicant, therefore, submits that there is no suggestion or motivation in Kouznetsov and Fortov of choosing an amplitude and a rise time of a voltage pulse to increase the density of ions in the strongly ionized plasma enough to generate sufficient thermal energy in the sputtering target to cause a sputtering yield to be non-linearly related to a temperature of the sputtering target.

In view of the above remarks, the Applicant submits that amended independent claim 1 is not obvious under 35 U.S.C. §103(a) over Kouznetsov in view of Fortov. The Applicant also submits that dependent claims 3 and 6-15 are allowable as depending from an allowable base claim.

Independent Claims 16 and 30 and Dependent Claims 17-19 and 23-25

Independent claim 16 has been amended to recite applying a voltage pulse to the cathode assembly to generate a strongly-ionized plasma from the weakly-ionized plasma. An amplitude and a rise time of the voltage pulse is chosen so that ions in the strongly-ionized plasma generate sufficient thermal energy in the sputtering target to cause a sputtering yield to be non-linearly related to a temperature of the sputtering target. Independent claim 30 has been amended to recite a sputtering source including a means for increasing the density of a weakly-ionized plasma to generate a strongly-ionized plasma that includes a density of ions that generate sufficient thermal energy in the sputtering target to cause a sputtering yield from the sputtering target to be non-linearly related to a temperature of the sputtering target.

As described herein, there is no suggestion or motivation in Kouznetsov and Fortov of choosing an amplitude and a rise time of a voltage pulse so that ions in a strongly-ionized plasma generate sufficient thermal energy in the sputtering target to cause a sputtering yield to be non-linearly related to a temperature of the sputtering target as recited in amended independent claim 1. In addition, as described herein, the Applicant believes that the sputtering yield in the apparatus described in Kouznetsov is not non-linearly related to a temperature of the sputtering target as recited in independent claim 30 and Fortov does not describe how to achieve the non-linear relationship between the sputtering yield and the target temperature.

In view of the above remarks, the Applicant submits that amended independent claims 16 and 30 are not obvious under 35 U.S.C. §103(a) over Kouznetsov in view of Fortov. The Applicant also submits that dependent claims 17-19 and 23-25 are allowable as depending from an allowable base claim.

Rejections under 35 U.S.C. §103 as being Unpatentable Over Kouznetsov in View of Fortov and in Further View of Chiang:

Dependent claims 4, 5, 20, 21, and 27-29 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kouznetsov in view of Fortov and in further view of Chiang et al., U.S. Pat. 6,398,929 (hereinafter "Chiang"). The Applicant has amended claims 4, 5, 21, and 27-29 to more clearly recite what the Applicant regards as the invention.

Dependent Claims 4 and 5

Dependent claims 4 and 5 depend on independent claim 1. As stated above, Applicant respectfully submits that independent claim 1 as currently amended is allowable over the prior art of record. Thus, Applicants submit that dependent claims 4 and 5 are allowable as depending from an allowable base claim.

Dependent Claims 20 and 21

Dependent claims 20 and 21 depend on independent claim 16. As stated above, Applicant respectfully submits that independent claim 16 as currently amended is allowable over the prior art of record. Thus, Applicants submit that dependent claims 4 and 5 are allowable as depending from an allowable base claim.

Independent Claim 27 and Dependent Claims 28-29

Independent claim 27 has been amended to recite a power supply that generates a voltage pulse between the anode and the cathode assembly that creates a strongly-ionized plasma from the weakly-ionized plasma. The amplitude and the rise time of the voltage pulse is chosen to increase a density of ions in the strongly-ionized plasma enough to generate sufficient thermal energy in the sputtering target to cause a sputtering yield to be non-linearly related to a temperature of the sputtering target. Independent claim 27 has also been amended to recite a gas controller that controls a flow of the feed gas to the strongly-ionized plasma to facilitate the creation of additional ions that generate additional thermal energy in the sputtering target.

The Office Action mailed on May 20, 2004 states that Kouznetsov in view of Fortov discloses substantially all features of claim 27 except that the gas exchanging and exchange means controller is not disclosed. The Office Action further states that Chiang suggests the use of a vacuum pump for removing a volume of gas as a volume of gas is admitted to the chamber from the gas source.

As described herein, the Applicant believes that the sputtering apparatus described in Kouznetsov uses a conventional sputtering process where the sputtering yield in the apparatus is substantially constant during the discharge pulses. Fortov describes the relationship between the

sputtering yield and the temperature of the target, but does not describe how to achieve the non-linear relationship between the sputtering yield and the target temperature. Chiang describes a DC sputtering apparatus with a gas exchange means that uses constant voltage instead of voltage pulses as recited in amended independent claim 27.

The Applicant, therefore, submits that there is no suggestion or motivation in Kouznetsov, Fortov, and Chiang of choosing an amplitude and a rise time of a voltage pulse to increase a density of ions in the strongly-ionized plasma enough to generate sufficient thermal energy in the sputtering target to cause a sputtering yield to be non-linearly related to a temperature of the sputtering target as recited in amended independent claim 27. Furthermore, the Applicant submits that there is no suggestion or motivation in Kouznetsov, Fortov, and Chiang of a gas controller that controls a flow of the feed gas to the strongly-ionized plasma to facilitate the creation of additional ions that generate additional thermal energy in the sputtering target as recited in amended independent claim 27.

In view of the above remarks, the Applicant submits that amended independent claim 27 is not obvious under 35 U.S.C. §103(a) over Kouznetsov in view of Fortov and in further view of Chiang. The Applicant also submits that dependent claims 28 and 29 are allowable as depending from an allowable base claim.

Rejections under 35 U.S.C. §103 as being Unpatentable Over Kouznetsov in View of Fortov and in Further View of Mozgrin:

Dependent claims 2, 22, and 26 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kouznetsov in view of Fortov and in further view of Mozgrin et al. "High-Current Low-Pressure Quasi-Stationary Discharge in a Magnetic Field: Experimental Research", Plasma Physics Reports, Vol. 21, No. 5, 1995, pp. 400-409 (hereinafter Mozgrin).

Dependent Claim 2

Dependent claim 2 depends on independent claim 1. As stated above, Applicant respectfully submits that independent claim 1 as currently amended is allowable over the prior art of record. Thus, Applicants submit that dependent claim 2 is allowable as depending from an allowable base claim.

Dependent Claims 22 and 26

Dependent claims 22 and 26 depend on independent claim 16. As stated above, Applicant respectfully submits that independent claim 16 as currently amended is allowable over the prior art of record. Thus, Applicants submit that dependent claims 22 and 26 are allowable as depending from an allowable base claim.

New Claims 31-42:

The Applicant submits that independent claim 1 is allowable as currently amended as described herein. The Applicant, therefore, submits that dependent claims 31-36 are allowable as depending from an allowable base claim. In addition, the Applicant submits that independent claim 16 is allowable as currently amended as described herein. The Applicant, therefore, submits that dependent claims 37-39 are allowable as depending from an allowable base claim. In addition, the Applicant submits that independent claim 27 is allowable as currently amended as described herein. The Applicant, therefore, submits that dependent claims 40-42 are allowable as depending from an allowable base claim.

Provisional Non-Statutory Double Patenting Rejections

The Examiner has rejected claims 1-30 under the judicially created doctrine of double patenting over claims 1-42 of copending Patent Application Serial No. 10/065,277 in view of Kouznetsov, Fortov, and Chiang et al. (U.S. Pat. 6,398,929). Copending Patent Application Serial No. 10/065,277 is assigned to the assignee of the present application.

The Applicant is submitting herewith a Terminal Disclaimer to Obviate a Provisional Double Patenting Rejection Over a Pending Second Application in compliance with 37 C.F.R. 1.321 as suggested by the Examiner in the Office Action. The Terminal Disclaimer was signed by the President of Zond, Inc., who is also the sole inventor of the present application. The Applicant is also submitting a Statement Under 37 CFR 3.73(b) that states that Zond, Inc. is the assignee of the entire right, title, and interest. An Assignment assigning the entire right, title, and interest in the present application to Zond, Inc. was recorded at Reel 013351, Frame 0573.

The Examiner also has rejected claims 1-30 under the judicially created doctrine of double patenting over claims 1-44 of copending Patent Application Serial No. 10/065,629 in view of Kouznetsov and Fortov. Copending Patent Application Serial No. 10/065,629 is assigned to the assignee of the present application.

The Applicant is submitting herewith a Terminal Disclaimer to Obviate a Provisional Double Patenting Rejection Over a Pending Second Application in compliance with 37 C.F.R. 1.321 as suggested by the Examiner in the Office Action. The Terminal Disclaimer was signed by the President of Zond, Inc., who is also the sole inventor of the present application. The Applicant is also submitting a Statement Under 37 CFR 3.73(b) that states that Zond, Inc. is the assignee of the entire right, title, and interest. An Assignment assigning the entire right, title, and interest in the present application to Zond, Inc. was recorded at Reel 013275, Frame 0037.

A fee transmittal authorizing the U.S. Patent Office to charge the $55.00 fee for each Statutory Disclaimer as set forth in 37 CFR § 1.20(d) is enclosed.

CONCLUSION

Claims 1, 2, 4-17, and 19-42 are currently pending in the present application. Claims 1, 4, 5, 6, 8, 12, 16, 19, 21, 25, and 27-30 are amended by the present Amendment. Claims 3 and 18 are cancelled without prejudice to Applicant's right to right to pursue these claims in this or a subsequent application. Claims 31-42 are added by the present Amendment. In view of the foregoing, reconsideration and allowance of all pending claims (i.e., claims 1, 2, 4-17, and 19-42) is respectfully requested.

The Commissioner is hereby authorized to charge the statutory disclaimer fees, the additional claims fee, and any other proper fees to Attorney's Deposit Account No. 501211.

If, in the Examiner's opinion, a telephonic interview would expedite prosecution of the present application, the undersigned attorney would welcome the opportunity to discuss any outstanding issues, and to work with the Examiner toward placing the application in condition for allowance.

Respectfully submitted,

Date: October 19, 2004
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